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EDITORIAL.

The Practical Application of Padi Experiments. Departing from usual practice, we include in this number an article which reviews the field experiments on padi over a number of years in place of our customary annual article in which details are given of the progress of work for the past season.

The introduction to the article records the first published mention of padi investigation by what was then the Department of Agriculture, F.M.S., refers to later experiments which may be regarded as the inception of work on the lines followed by subsequent investigations, records the conclusions drawn from those investigations and indicates where experience has suggested that modifications in procedure may prove to be desirable and beneficial. A review of the work at the Experiment Stations will be published in the next number of this Journal.

Farmers the world over have a reputation for conservatism, and any reluctance shown by padi planters to accept innovations cannot be considered unique. The farmer's livelihood depends upon the success of his crop and he is therefore inclined to adhere to principles based on generations of experience, principles which have stood the test of time and which he feels confident will lead to success, rather than be led into acceptance of new methods which, in his opinion, have not been put to the test.

This article, however, provides proof that where padi is a commercial crop the cultivator has shown himself ready to adopt such improvements once he is satisfied that he will reap benefit therefrom. It also furnishes considerable data to support his reluctance to adopt new methods until it has been demonstrated to his own satisfaction that such are an improvement on old established practice.

The Malayan Agricultural Service has in large measure secured the co-operation of padi planters by reason of the chain of Experiment Stations and Padi Test Stations established throughout the country. These Stations have at all times been open to the planters' inspection and in most districts cultivators have taken advantage of this open invitation.

The work done at these Stations is not spectacular, but its propaganda value is undoubted, and we are now seeing its results by the greater degree of confidence between the investigator and the cultivator. Such demonstration work has become an integral part of the long sustained effort to improve the lot of the padi planter by making it possible to obtain heavier crops of better quality; in other words, to make padi planting a more economic proposition.

Original Articles.

A REVIEW OF FIELD EXPERIMENTS ON PADI IN MALAYA

By

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Introduction.

It has been customary for the past ten years to publish in the December number of this Journal an account of the past season's work on padi experiments. In more recent years this account has been concerned mainly with field experiments designed to determine the comparative yields at the numerous Padi Experiment and Test Stations of the higher-yielding strains selected at the Experiment Stations of Telok Chengai in Kedah, Titi Serong in Perak and Pulau Gadong in Malacca, and numerous detailed results have been published annually in tabular form.

During the past year the whole question of field experimental work on padi selection, the testing of promising strains, and the distribution to cultivators of those considered suitable has been brought under review with the object of ascertaining if any modifications of past technique and practice were desirable. The conclusion was reached that past work had been on sound lines generally but that, in the light of the experience gained, there appeared to be grounds for some modification of outlook combined with a few changes in standard practice and that a case existed for investigating the soundness of certain other details in the standard procedure employed. The object of this article is to review the ground covered up to the present by field experiments on padi and, in respect of selection and tests of pure strains and their distribution, to recount results in sufficient detail to provide a reliable register for reference. Mention will be made of the modifications in procedure that have been deemed advisable, of the investigations that are being undertaken into selection technique, and the padi field experiments of the past season will be summarized.

The first account of experiments with padi by the Department of Agriculture was published in 1911 in Vol. X of the *Agricultural Bulletin* of the Straits and Federated Malay States and this was followed by further articles in the first two volumes of the first periodical of the Federated Malay States Department of Agriculture, the *Agricultural Bulletin*. The only practical interest these earlier articles now have is that although the importance attached by the writers to improved irrigation and its efficient control has been fully justified, experience has shown that the matter of economically increasing yields by the application of manures is a much more complicated problem than was imagined and one which still awaits solution. The same remarks apply generally to methods of cultivation, whilst improvement

to the yields of padi in the country generally by means of selection and hybridization has not proved quite so easy of accomplishment as was once visualized, although selection has resulted in very definite and permanent gains in some areas.

No further mention of padi experiments was made in the Bulletin until December, 1917, when there was a note on the random variance encountered in a field for padi experiments in Negri Sembilan. A preliminary report on padi experiments in Krian was published in October, 1919, and this includes an account of ear-to-row selection of high-yielding strains at Titi Serong Experiment Station which work was inaugurated in 1916 and has been maintained and further extended without material change in the methods originally used.

In 1930 special consideration was given to the requirements in respect of padi experiments, and the Rice Cultivation Committee endorsed the programme which had been drawn up by the Department of Agriculture and recommended that, as far as possible, provision should be made to enable field experiments on similar lines to be conducted in the Unfederated States as well as in the Federated Malay States and Straits Settlements Consequently that year marks the beginning of a period of more concentrated and organized effort than before by the Agricultural Services of Malaya on padi problems and the establishment of a chain of Departmental Padi Experiment and Test Stations at suitable centres in nearly all the important padi-producing areas of Malaya. The notes on the present position given in the next section are based on experiments conducted during these past ten years.

Brief Notes on the Present Position.

Manuring.—The results obtained from numerous standard experiments conducted on many Stations, as well as those from many experiments conducted at only one Station generally designed to elucidate problems specially concerning a particular area, have been published from time to time in the *Malayan Agricultural Journal.* Some of these have been concerned solely with manurial treatments, whilst others have combined manurial treatments with variations in methods of cultivation. The position to date was reviewed in broad outline in the December, 1936, number of this Journal and again summarized in December, 1939, and those summaries should be read in conjunction with these notes. Subsequent experiments have not materially altered the general position. The application of varying amounts of green dressings, whether combined or not with chemical manures, has thrown no fresh light on the problem: nor has the application of slow acting organic nitrogenous manures given the increases in the field that were anticipated because of the results obtained from the use of ground horn in pot experiments. On the other hand it has been shown that wet padi on certain of the heavier soils of Kelantan is more responsive to applications of phosphates and nitrogen than is the case on the western side of the Peninsula. On certain light soils in Kelantan wet padi has similarly responded to applications of green manures combined with dressings of phosphates and nitrogen.

On general grounds it would seem that the customary practice in Kedah of applying once every few years a dressing of guano which is obtained locally at low cost, and the application of guano and cowdung in Kelantan and of locally ground bones in Malacca are justified: but, in so far as our experiments show, those cultivators in other areas who apply no manure would appear to have equal justification for not adopting the practice obtaining elsewhere.

The practice customary in some areas of dipping seedlings in a mixture of guano and water prior to transplanting more probably owes any advantage which may accrue in respect of yields to decreased mortality of transplanted seedlings rather than to any direct effect of the manure applied. Support for this view is provided from the fact that greatly increased growth obtained from manured plants in nurseries led to no response in respect of subsequent yields.

In certain areas of Krian it has been established that decreasing yields are associated with a distinct change in the flora of fields when under fallow. This fact has led to the formulation of experiments designed to ascertain whether any system of manuring the fallow vegetation is likely to provide the solution which experiments with direct applications have failed to give to the problem of how manures can be economically employed to increase the padi yield on the western side of the Peninsula. From their very nature these experiments are necessarily of long range. They are being laid down after the 1940-41 harvest.

Cultivation.—The methods of preparing the land for a wet padi crop in Malaya, though differing in matters of detail from place to place, can be grouped under two main heads. On the one hand there is the practice of ploughing and harrowing typical of Kedah, Kelantan and Malacca: on the other hand is the simple process of cutting down the fallow growth just below the surface of the soil by hand with a tool specially designed and peculiarly well fitted for the purpose and rotting the cut vegetation under water to a greater or less extent before planting operations commence. This latter method is typical of Krian and of the great majority of the padi areas of the western side of the Peninsula except Kedah, parts of Province Wellesley, Negri Sembilan and Malacca.

With both systems the operations are done when the land is wet and the cultivators prefer that it should be covered with water, a condition essential, of course, for efficient puddling. Associated with these two distinct systems of cultivation are two distinct ways of employing the water the crop needs. The puddling of the soil induced by the ploughing, and more especially by the subsequent harrowing of wet soil, prevents percolation and, whether the supply be naturally from rainfall or artificially from a canal, this enables the water to be retained on the surface even though the natural water table may be many feet below. On the other hand, where the other method of cultivation obtains the flooding of the fields is brought about by raising the water table above the surface of the soil. The term irrigation is customarily used for both methods if the supply is from a canal, but the term inundation serves to differentiate them and is a more fitting one to denote flooding by raising the water table above the surface.

Experiments conducted on the inundated lands have shown that, in so far as the higher-producing areas are concerned, little if any increase in yields can be expected as the result of deeper or more thorough tillage of the soil. There are grounds for a general assumption that the puddling of the soil is mainly, if not entirely, advantageous because it enables land to be flooded and that it is a minor factor in so far as its direct effect on growth and yield is concerned, if indeed it has any direct effect whatsoever in this respect.

There are, however, certain areas, as for example south-east Krian, where the yields obtained are consistently below what the mechanical and chemical composition of the soil would appear to warrant. In one such area, Selinsing, increased yields have been obtained experimentally from deep cultivation, though the increase obtained was not commensurate with the cost of the operation and would only be economically justified if it could be shown that a substantial residual effect would be maintained over many consecutive seasons. An experiment has been laid down to test the effect of cattle keeping in conjunction with padi cultivation in this area, the possibility being assumed that should ploughing alone effect no improvement a combination with it of grazing during fallow and the use of cattle manure may result in better crops.

In Kelantan, deeper cultivation has given an increased yield for dry padi. Experiments are in progress with several different ploughs in an endeavour to effect deeper cultivation without unduly increasing the draught.

An experiment conducted over several consecutive seasons at Bukit Merah Station in Province Wellesley has shown that increased yields of padi have resulted from growing vegetables during the padi intercrop season in replacement of the more usual fallow rotation. A modification of this experiment laid down on the same Station in the 1939-40 season gave increased padi yields on plots where no manure was used on the vegetable crop as well as on the plots where the vegetables were manured in the customary manner, even though the vegetables on the unmanured plots were a failure. This experiment is being laid down on several other Stations after the 1940-41 harvest.

Selection and Comparative Yield Experiments, & Distribution of Pure Strains. At an Agricultural Conference in 1933 rules for standard procedure were adopted for the guidance of all concerned with padi selection. This procedure was based on the assumption that the strain of padi most likely to produce the heaviest crop under field conditions would be one of which each plant had been shown to produce the heaviest weight of grain when given room to develop to its fullest capacity. Recorded data appeared to warrant this assumption for, in respect of both experiments on Stations and measurements made in the field on cultivators' land, yields of distributed pure strains were higher in the majority of cases than those of local unselected varieties.

It was recognized that ear-to-row selection of high-yielding strains necessitated much detailed field inspection and recording which was beyond the capacity of the small staff employed on the majority of the Padi Test Stations so it was agreed that ear-to-row selection should be confined to the three larger Experiment Stations and that they should deal with material from the areas detailed below:—

(1) Titi Serong Station in Krian. All varieties from Perak and Province Wellesley. All long-season varieties from Pahang, Selangor and Negri Sembilan.

(2) Pulau Gadong Station in Malacca. All short-season varieties from Malacca, Pahang, Selangor and Negri Sembilan.

(3) Telok Chengai Station in Kedah. All Kedah varieties.

The Stations of Kota Bharu in Kelantan and Talang in Perak were later approved as selection Stations, the former to deal with Kelantan varieties, and the latter to deal with the short-season varieties formerly assigned to Titi Serong but for which this last named Station had proved unsuitable.

The standard procedure adopted is given briefly:—

(a) Preliminary Selection. Grains to be collected at random in the field from promising varieties and at least 500 single plants grown at the appropriate Station for the area in which the collection of grain is made. Spacing between rows to be 3 ft., the distance in the row to be the average planting distance for the locality concerned. After discarding weak plants, those with unsuitable characters, and those with yields obviously below average, the weight of ears from each of the remaining plants to be recorded and if these are deemed sufficiently high to warrant further trial, three good ears from each of a number of the heaviest yielders to be sent to the appropriate selection Station for ear-to-row trials.

It was specifically laid down that preliminary selection in the field should be of single grains and not simply a selection of heavy ears, because a heavy ear does not necessarily denote a high-yielding plant, capacity for tillering being another important factor. No estimation can be made in the cultivators' fields of the relative importance of these two factors as a "hill" of padi is made up of several plants: in areas where young seedlings are transplanted direct from the original nursery as many as twenty plants may be used for one hill in a season when seedlings are plentiful.

(b) Ear-to-Row Selection. Standard planting distance to be $2\frac{1}{2}$ ft x $1\frac{1}{2}$ ft. At least one plant in a row to be bagged. Pure seed of all strains issued from a selection Station to be maintained by bagging a sufficient number of plants to provide the seed required for the next season's plot of the strain on the Station concerned. It was later laid down that plants of a suitable proved high-yielding pure strain should be planted at intervals in ear-to-row lines to provide a standard for comparison with the strain under selection so as to furnish a guide to variation from season to season.

(c) Comparative Yield Experiments. At the time the rules for standard procedure were adopted it was generally accepted as standard policy that the detailed results of all padi experiments conducted by the Field Branch throughout the country should be forwarded to the Research Branch at Headquarters for statistical analysis. In order to facilitate dealing with the large amount of work occasioned by the increased number of experiments resulting from the opening of Padi Test Stations throughout the country, it was laid down that all comparative yield experiments should be conducted on standard 4 x 4 or 5 x 5 Latin Squares.

The standardization applied to both the size of plot and arrangement of plots in the square as well as to planting distance and method of planting, designed to give a standard number of plants in each plot. Another reason for adopting a rigid lay-out was to minimize irregularities and mistakes in field procedure as far as possible, such having been somewhat frequent in the past. The standard lay-out provided for a plot of 1/120th acre, a size which had been previously ascertained to be suitable, as against a plot of 1/40th acre used previously for the form of randomized block lay-out which had been found definitely unsuitable in several respects for padi experiments in Malaya.

(d) DISTRIBUTION. In reviewing the position at the 1933 Conference it was noted that considerable distribution of the Pulau Gadong strain Siam 39 had been made in Malacca and that the demand for it exceeded the supply. In the aggregate a large amount of seed of several of the Titi Serong strains had been distributed over a period of several years in most parts of the country, generally in small amounts to individuals, and it seemed probable that in the District of Krian itself a very large proportion of the padi grown was derived from this seed, although no definite data were available to support this assumption. On the other hand it was pointed out that published statistics gave no indication that cultivators had benefited, for returns showed no marked increase in yields per acre and it was admitted that in some parts of the country there existed a prejudice against Government seed and, even in the Krian District, cultivators showed no general desire to obtain it. A common complaint in areas outside Krian was that the Titi Serong strains lacked flavour as compared with the local varieties commonly grown.

The Conference decided that there was need for better organization and more discrimination in respect of distribution; that the aim should be to popularize one suitable strain in any locality rather than to distribute a number of strains of one variety; that more rigid tests of the high-yielding capacity of a strain were required before any attempt should be made to recommend it to cultivators; that, when a strain had proved its worth, every endeavour should be made to bring it into general cultivation by propaganda and demonstrations on Test Stations.

Modifications and Investigations in respect of Standard Procedure.

In the first place it has become obvious that decentralization in many respects and for a number of reasons is essential.

The rule that all statistical analysis should be done at Headquarters, though very desirable in the initial stages of a programme that provided for more precise and critical experiment work, is no longer practicable and experience has shown that such centralization has grave disadvantages. The amount of work from one season's comparative yield experiments has become so large as to be beyond the capacity of any one officer to deal with in time for it to be of use in formulating a programme for the coming season.

Furthermore, it has become increasingly evident that tabulated figures in themselves are only an incomplete guide and it is necessary to examine them in the light of knowledge of the field history of the experiment throughout the season if a correct evaluation of the relative worth of the strains used in the experiment is to be made.

An additional reason for devolution in respect of both the evaluation of results and the formulation of a season's programme of experiments, is that past work has served to emphasise that there are a variety of reasons why a strain eminently suited to one locality may be totally unsuited for another. The following four examples will serve to show what is meant:—

(i) The Pulau Gadong strain Siam 29, after several consecutive seasons' tests on Stations against many other strains, was considered to be the most promising for the southern half of Krian District, an important area in Perak where padi is grown as a commercial crop. A single season's supervised trials by cultivators on their own land served to shatter the hopes entertained for this strain. The strain has weak straw and became badly laid, and the main reason for its condemnation was that the cost of reaping proved to be some 20 per cent. above that of local varieties. An additional reason was the low weight-volume ratio of its grain, which would be a matter of small importance in non-commercial areas where padi is always measured by volume and never by weight. For more detailed information see *Malayan Agricultural Journal* Vol. XXVIII, p. 429.

(ii) The Titi Serong strain, Seraup 36, had a reputation in early days for high yields. Subsequent experiments and check yields on measurements in the field gave conflicting results and it was only after many seasons' trials that it was found that frangibility (easy shedding of ripe grain) rendered this strain unsuitable for general use and led to its being discarded in favour of Seraup 48 as the standard strain for distribution in Krian.

(iii) On many Stations in Krian, Seraup 371 has given consistently higher yields than Seraup 48 and it required the examination of results from many experiments before it was determined that the standard strain holds the advantage for general use because it is less affected by vagaries of weather and irregularities in water supply and soil fertility. It is, in short, a hardier strain.

(iv) For the past three seasons several strains of Mayang Sa'Batil have given higher yields than our best Seraup strain on many Stations in Perak. Infrangibility is a characteristic of this variety and the probability that, if it were brought into general use in Krian, some modification of present threshing practice would be required has militated against advocating its distribution. The possibility of devising fresh threshing methods likely to appeal to the cultivator is receiving attention.

The terms commercial and non-commercial padi areas have been used earlier in this article. The latter denotes something more than an area where padi is not ordinarily grown for sale; in normal times the cultivator is so little interested in producing more padi than will meet his domestic requirements that it almost seems that he views a surplus as an embarrassment. These are the areas where one can

expect as a matter of course complaints against the flavour and quality of any introduced varieties and the chances of such being brought into general cultivation are small, even though there should be undisputed proof that they yield better than the variety to which the cultivator has become accustomed. It is obvious that for these areas the more promising line of attack is to select high-yielding strains from local varieties which stand more chance of acceptance by the cultivator, in the hope that in times of stress he will be able to obtain a better crop than he could from his unselected varieties. In past rubber slumps the increased industry shown in padi growing in these areas has been in marked contrast to the poorer cultivation of normal times and provides evidence that the *laissez faire* attitude of normal times results from lack of incentive rather than lack of knowledge of padi cultivation.

Apart from the problem peculiar to the non-commercial areas the general trend of past experience has been to show that there is a case for increasing the number of selection centres. Accordingly the earlier restrictions in this respect have been removed. The fact that none of the Titi Serong strains have been brought into cultivation over any extensive area outside Perak, even though they have given good yields on several Stations in other parts of the country, provides support for increasing the number of selection centres where popular varieties can be selected under conditions where the special requirements of those varieties obtain and by an officer familiar with both the needs and peculiarities of the locality concerned.

The chief matter concerning which further investigation is considered desirable into the validity of present methods is that of selection technique.

It was pointed out that, although past experiments on planting distances designed to include the full range of spacing normally practised in this country had shown no difference between treatments for either of the two strains used, it has to be remembered that both those strains had been selected for heavy yield per plant. Hence the possibility has not been ruled out that some of the discarded lines might have given better results in the field than those retained. If this is so, such discarded lines would have had more chance of being retained had selection been done on closer spacing than that laid down.

Data from recent experiments, in which one strain used is known to be of comparatively low tillering capacity and high weight of grain per ear, support the case for further investigation.

With this object in view an experiment was commenced last season which provides for the examination in ear-to-row lines (with both wide and close spacing) and subsequently in field trials, of a number of plants chosen in preliminary selection for desirable vegetative characters, but which show a wide range in respect of yield per plant. This experiment is necessarily one that will require several seasons for completion.

Notes on the Results obtained in Manurial and Cultivation Trials in the 1939 - 40 Season.

The following notes have been prepared by the Senior Soils Chemist.

As forecast in the summary on padi manurial and cultivation trials given in the December number of the *Malayan Agricultural Journal*, 1939, comparatively few experiments were carried out at west-coast Stations during the season.

West Coast—Cultural.—A close planting experiment was laid down at six Stations, Bukit Merah, Telok Chengai, Titi Serong, Talang, Sungei Manik and Pulau Gadong. The object was to ascertain whether close planting would increase the yield per acre and whether manuring would be more effective on closer planted padi. Padi was planted at the normal distance, 1 ft. x 1 ft. and close 5 ins. x 5 ins. The effects of nitrogen alone and nitrogen and phosphate dressings were also investigated.

Results from Pulau Gadong were considered valueless owing to outside causes. The results from Sungei Manik were seriously interfered with by a fungus disease, so were also not amenable to statistical examination. As, however, the close planting plots were specially affected and there are grounds for considering that the close planting was a factor favourable to the disease, it can be assumed that close planting is wrong practice at Sungei Manik under the conditions obtaining last season. At Telok Chengai closer spacing gave significantly higher yields but at the other three Stations the wider spacing gave better results. Manurial dressings had no effect. When consideration is paid to the economic factor it would seem that normal planting is more profitable.

A long term experiment on the method of disposal of straw which had been running at Telok Chengai for some seasons was continued. Results, whilst confirming the previous conclusion that the removal of straw was not beneficial, also showed an indication that burning might be beneficial.

An experiment at Pulau Gadong on the period of the preparation of land before planting gave valueless results.

West Coast—Manurial.—On the west coast one manurial experiment was carried out at Telok Chengai and three at Pulau Gadong.

At Telok Chengai an experiment on the use of bat guano and rock phosphate gave no significant results.

At Pulau Gadong an experiment replicated nine times on the lateral spread of cattle manure dressings gave no conclusive evidence, but there appeared to be little spread of the manurial effect either with the water flow or through the bunds.

The other two experiments, on the effect of manuring combined with water control and the manuring of Seraup type of padi, suffered so badly from drought and incidental causes that no conclusions could be drawn.

East Coast—Manurial.—Manurial experiments on east coast Stations were carried out at Kota Bahru, Bachok and Pasir Puteh.

At Kota Bahru four experiments on the effect of bat guano, rock phosphate, and ammonium sulphate were negative.

An experiment on the use of green dressings and cattle manure at the rate of 3 tons per acre showed significant increases due to cattle manure only.

At Bachok rock phosphate at the rate of 2 cwts. per acre and rock phosphate plus ammonium sulphate dressings gave significant increases over green manuring at 5 tons per acre.

An experiment on the use of green dressings, cattle manure, and compost showed non-significant increases due to the dressings.

A similar experiment on dry padi gave no significant results although cattle manure dressings showed a considerable increase in yield.

At Pasir Puteh, the residual effect of dressings of 2 cwts. of rock phosphate, with and without additional nitrogen or green manure, gave significant increases.

MANGOES IN KRIAN

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Introduction.

The genus Mangifera is well represented in Malaya with some twenty species, of which at least nine are common fruit trees of the *kampong*. Recently E. J. H. Corner has recorded in "Wayside Trees of Malaya" what is known of Malayan species(1). In many parts of Perak the introduced Indian mango is planted on the bunds separating the rice fields; in Krian the trees are established in quantity and a regular market obtained for the fruit produced.

During recent years investigations have been conducted with the mangoes grown and sold in Krian and information of a preliminary nature secured. The subject was discussed with Sir Frank Stockdale, K.C.M.G., then Agricultural Adviser to the Secretary of State for the Colonies, who after inspecting the trees in Krian, recommended that experimental trials should be made(2).

The crop in November, 1939, was a heavy one extending for over a month. The opportunity was taken of examining both the fruit picked for sale and the fruiting trees in order to distinguish the main varieties grown and select certain trees of desirable type for possible supply of clonal budwood.

Subsequently a small nursery area was laid out at Briah Padi Test Station in south Krian, where seedlings were raised and preliminary budding undertaken. In May, 1940, the Government of Perak approved special expenditure for the purpose of opening a Station at Simpang Lima in the centre of Krian for the purpose of isolating and propagating desirable mangoes for distribution, and conducting cultural and other investigations. In November, 1940, budded plants grown at Agricultural Stations were transferred to the new Station.

In the present paper it is proposed to describe the investigations so far undertaken with mangoes in Krian, with special reference to those varieties with fruits of good quality and marketable value.

Climatic Considerations.

The mango is essentially a tree suitable for cultivation in countries in which there is a marked dry season. This is demonstrated in India; in Lower Bengal where the climate is humid throughout the year, mangoes rarely fruit well, whereas on the plains of Northern India which have a marked dry period, the trees flower profusely in dry weather and the fruits develop and ripen well. Malaya, therefore, with its heavy rainfall distributed throughout the year, although not essentially even, is not a country in which the best varieties, most of which have been selected in dryer conditions, would be expected to flourish or give even moderate yields. In certain areas of Malaya, however, fair crops of fruit may be obtained in spite of the

unfavourable climate. This is probably because there is some factor which is acting as a check to the growth of the trees in the same way as the change from the wet to the dry season does in other countries; for instance in Krian, which is essentially a padi area with controlled irrigation, it is probably the periodic inundation and draining that causes the mango to fruit. The crop is uncertain except for the more coarse varieties but this is to be expected as, even in the most favourable districts in India, the best varieties tend to be uncertain bearers. However, the crop that is obtained in Krian is of fair quality and sufficiently large to supply the towns for fifty miles around, and the Malay who has four or five good trees in his holding makes considerable profit.

Existing Trade in Krian.

Mangoes are found in all mukims of Krian but they are most frequent in Krian South. They are generally planted on the bunds between the fields or on reclaimed land surrounding the houses and so it is difficult to estimate the area planted. Counts have been made at various times and it is estimated that in Bagan Serai *mukim* alone there are some 13,000 trees. They were planted in most instances by the original settlers, many of whom were Banjarese, chiefly for home consumption, but supply soon became sufficient for a considerable quantity to be sold.

The trees fruit twice a year, in May/June and from mid-October to mid-December, but in most seasons fruit can rarely be bought on a large scale for more than a month. The fruit is cropped by means of a hooked knife attached to the end of a long bamboo pole. Climbing is seldom practised owing to the presence of red ants (*kerengga*) on the trees. Most of the crop is picked slightly unripe and is artificially coloured by means of calcium carbide. This is generally done in soap boxes or baskets lined with banana leaves on which the calcium carbide is sprinkled; the receptacle is filled to the top and the fruit covered with more leaves on which more calcium carbide is often scattered. After two or three days the colour of the fruit becomes uniform and the consignment is ready for sale. This practice has apparently become widespread during the past six or seven years and it results in rather insipid fruit. Artificial ripening as practised may be the cause of the theory held by many of the local Malays that the quality of the Krian mangoes has deteriorated during recent years. In some seasons a small quantity of the fruit of the coarser varieties is picked in a very unripe condition and sold in the towns for making chutney.

The fruit is generally sold to Chinese pedlars who visit the padi fields in order to collect it. In the case of really good trees the fruit may be sold on the tree, the pedlars undertaking the collecting and ripening. At the roadside the fruit is packed in baskets and sent by rail and lorry to the neighbouring towns. During October and November, 1939, it was estimated that 2,000 baskets were despatched by rail from stations in Krian South, in addition to the many that were transported by road. Each basket may contain from 300 to 2,000 fruits, according to variety, and on an average is worth about $4 (Malayan currency).

Classification of Mangoes Commonly Grown.

The mangoes commonly met with in Krian belong to three species. These are as follows:—

Mangifera indica, L. Indian Mango. Mempelam (M).—The best marketable varieties belong to this species. The trees have been raised from seed but there are frequent importations from India, Siam, Java and Sumatra.

Mangifera pentandra, Hook, f. Mempelam Bemban (M).—According to Corner the variety Ayer which is commonly met with in Krian may belong to this species, as distinct from *M. indica*.

Mangifera odorata. Griff. Kwini (M).—The origin of this species is uncertain but wild trees have so far not been discovered in Malaya. Trees in Krian South bear good quality fruit which always obtains a high price.

In addition to the above species there are several others which are fairly common and often fruit heavily, but the fruit is rarely plucked and is of little economic importance.

Mangifera foetida, Lour. Horse Mango, Machang (M).—This is a wild species and the fruits of many trees are unpalatable, but there are sweet forms which well might be improved by selection. Outside Krian the *machang* is in better demand and good fruit sell rapidly.

Mangifera longipetiolata, King. Sepam (M).—A wild species reported as occuring in mountain forests. The fruit is rounded and plump, ripening yellow-green.

Mangifera Maingayi, Hook, f. Machang Pulasan (M).—This wild species, which is similar to *M. foetida*, has fruit with white flesh and a fibreless oval stone.

Mangifera quadrifida, Jack. Asam Kumbang (M).—Although wild this mango is common in the *kampong*. The fruits are round and plump and ripen dark purple. The yellow flesh is fibrous and rather sour.

The binjai, *M. caesia*, Jack, does not occur in Krian. This is an introduced fruit with sweet-fruited forms known as *binjai manis*, which are very much in demand. The propagation of selected clones of the binjai is desirable since it is a popular fruit with Malays, is readily saleable, and fruits well in most districts.

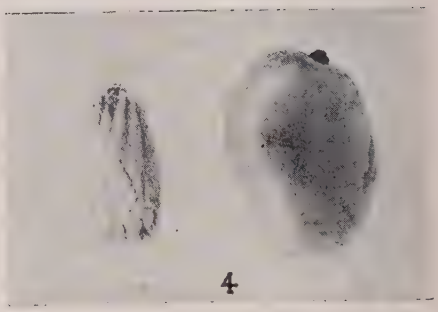
Fruits of the Indian mango, *mempelam bemban*, and Kwini have been examined in detail and over forty types were collected. Most of these, however, were found to fall into the following varietal groups, all of which are recognized by the trade. Great difficulties were experienced with the vernacular names as many growers have given their varieties special ones, but those recorded are most extensively used in Krian.

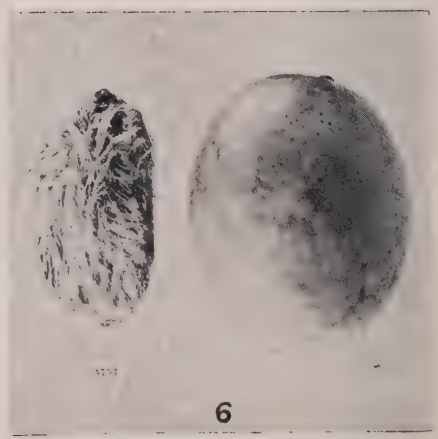
A. *Mangifera indica*.

Timun. Plate I, Fig. 1. Tree up to 30 ft. high, with very long narrow leaves, bearing at most 300 fruits per season. Fruit large, 160-200 by 65-80 by 60-65 mm., weighing 400 to 500 gms. Form oblong, slightly curved and narrowing towards the apex; stem inserted squarely with no depression, nak conspicuous. Colour green,

Varieties of *Mangifera indica*: 1, Timun; 2, Sourabaya; 3, Mangga; 4, Siam; 5, Seri Kaya.

PLATE II.





Varieties of *Mangifera indica*: 1, Pisang; 2, Cheti; 3, Telur; 4, Acheh. Other species: 5, *Mangifera pentrandra*, Ayer; 6, *Mangifera odorata*, Kwini.

turning yellowish when ripe; skin smooth with numerous white lenticels. Flesh orange when fully ripe, becoming reddish near the stone; flavour good, juicy with few fibres. Seed 130-155 by 35-40 by 20-23 mm., oblong, well-filled and covered with fine hair.

There are not more than 30 trees of this variety in Krian, all of which are in Bagan Serai and Briah.

Prices of fruit: 12 cents per fruit on tree, 12 to 18 cents per fruit in market.

SOURABAYA. Plate I, Fig. 2. Tree about 20 ft. high, in general similar to Timun in shape and size but the leaves are shorter and broader. Bears about 200 fruits per season. Fruit large, 95-120 by 63-70 by 55-60 mm., weighing 275 to 350 gms. Form ovate, slightly asymmetrical, plump, almost circular in cross section; stem inserted off-centre, nak inconspicuous. Colour orange-yellow with paler lenticels often very conspicuous; skin smooth. Flesh orange of good flavour, skin rather thick; good types have few fibres; taste good and more juicy than most. Seed 85-95 by 35-40 by 12-22 mm., oblong, flattened, and covered with short fibre.

Not many trees are to be found, all in Krian South.

Prices of fruit: 3 to 6 cents per fruit on tree, 5 to 8 cents per fruit in market.

SERI KAYA. Plate I, Fig. 5. The tree is indistinguishable from Sourabaya. Fruit medium sized 115-135 by 60-65 by 55-60 mm., weighing 240 to 255 gms. Form ovate, asymmetrical, beaked and plump; the stem is inserted off-centre with extended base, nak not conspicuous. Colour yellow turning pinkish when ripe; skin smooth with few lenticels. Flesh yellow to orange, often of very good flavour with no fibres. Seed 110-115 by 40-45 by 12-15 mm., oblong, very narrow, often only swollen for half its length.

There are but few trees, all in Krian South.

Prices of fruit: 3 to 6 cents per fruit on tree, 5 to 8 cents per fruit in market.

SIAM. Plate I, Fig. 4. Tree up to 30 ft. with a wide span and long and rather broad leaves. Often bears up to 500 fruits per season. Fruit medium sized 95-110 by 60-70 by 45-55 mm., weighing 220 to 225 gms. Fruit oblong-oval, plump, stem inserted slightly off-centre, generally in the depression, nak inconspicuous. Colour yellow, yellowish-green, or even with pinkish tinge; skin smooth often rather thin, generally with many lenticels. Flesh orange of fair flavour, generally fibrous. Seed 75-85 by 37-45 by 17-20 mm., oblong, flattened, covered with fibres which are often rather coarse.

There are many trees throughout Krian.

Prices of fruit: $1.30 to $3 per 100 fruits on tree, 2 to 4 cents per fruit in market.

MANGGA. Plate I, Fig. 3. Tree up to 20 ft. with fairly long leaf. Fruit medium sized, 85-115 by 65-75 by 50-60 mm. weighing 250 to 285 gms. Form ovate, slightly beaked, plump, slightly depressed, stem inserted off-centre on a small excrescence, nak inconspicuous. Colour greenish-orange when ripe, skin smooth

with numerous brownish lenticels which give the fruit a characteristic appearance. Flesh golden-yellow with few fibres; skin thin; flavour fair, only slightly oily. Seed 70-90 by 35-40 by 17-20 mm., oblong, plump, covered with short fibres.

There are numerous trees in Briah and Bagan Serai.

Prices of fruit: $1.30 to $3 per 100 fruits on tree, 2 to 4 cents per fruit in market.

Pisang. Plate II, Fig. 1. Tree up to 20 ft., leaves long but shorter than those of Timun; it can be recognized by its leaves; bears up to 300 fruits per season. Fruit medium-sized, 70-105 by 42-50 by 35-40 mm., weighing 115 to 165 gms. Form oblong, ovate, prominently beaked, almost circular in cross section, stem inserted almost squarely with extended base, nak conspicuous. Colour yellow to golden-orange, lenticels few in number of paler colour, skin smooth and thin. Flesh generally of good flavour but sometimes very oily, free from fibre. Seed 80-100 by 35-40 by 17-20 mm., oblong, flattened and covered with short fine fibre.

There are many trees all over Krian.

Prices of fruit: 70 cents to $1 per 100 fruits on tree, 8 to 12 cents per 10 in market.

Cheti. Plate II, Fig. 2. A fairly large tree up to 30 ft., with a good spread; leaves normal and hard to recognize. Bears up to 400 fruits per season. Fruit rather small 65-80 by 65-85 by 45-60 mm., weighing 150 to 220 gms. Form asymmetrical, cordate, flattened, stem inserted in a depression, nak evident. Colour golden-yellow, often with a pinkish tinge; skin smooth with a few paler lenticels. Flesh orange with good flavour, skin thin; the quality varies, some very good while others are fibrous. Seed 50-70 by 38-45 by 15-19 mm., ovate-caudate, very flattened, covered with fibres which in a good type are very fine.

This variety is fairly common in Krian South.

Prices of fruit: $1.80 to $3.50 per 100 fruits on tree, 2 to 5 cents per fruit in market.

Acheh. Plate II, Fig. 4. A tree up to 30 ft., with a large spread and small trunk. Bears about 600 fruits per season. Fruit small, 75-85 by 55-60 by 43-50 mm., weighing 105-150 gms. Form oblong-ovate, slightly asymmetrical; base flattened, stem inserted off-centre with extended base, nak conspicuous. Colour yellowish-orange when ripe and in some case pinkish; skin smooth with white lenticels. Flesh yellow, very juicy with few fibres, flavour poor and rather acidic. Seed 60-70 by 32-35 by 18-20 mm., oblong, plump, covered with short fibres.

There are many trees in Krian South.

Prices of fruit: 30 to 60 cents per 100 fruits on tree, 4 to 8 cents per 10 fruits in market.

Telur. Plate II, Fig. 3. A small tree up to 20 ft., leaves generally small; it can be recognized by the size of the leaf and their faint smell. Bears from 800 to 1000 fruits per season. Fruits small 35-60 by 40-60 by 30-40 mm., weighing 40 to 65 gms. Form asymmetrically cordate and laterally flattened, stem inserted in

depression with swollen base, nak noticeable. Colour greenish-yellow often with a pinkish tinge, skin smooth with a very few small lenticels. Flesh orange with some fibre and sweet in taste. Seed rather large, 30-45 by 25-30 by 14-16 mm., oblong, covered with short fibre.

There are many trees all over Krian.

Prices of fruit: 15 to 50 cents per 100 fruits on tree, 2 to 6 cents per 10 fruits in market.

B. *Mangifera pentandra.*

Ayer. Plate II, Fig. 5. A large tree up to 40 ft., trunk large, leaf small, similar to that of Telur but deeper green; it can easily be recognised by its size and shape; bears up to 200 fruits per season. Fruit medium-sized 75-100 by 60-70 by 50-60 mm., weighing 200 to 280 gms. Form oval, only slightly flattened, stem inserted off-centre in slight depression, broadly beaked, nak inconspicuous. Colour green to yellowish-green; skin smooth with numerous dark green lenticels. Flesh yellow turning darker near the seed, very juicy and fibrous but of fair flavour only. Seed 70-95 by 35-50 by 20-25 mm., oblong, covered with fibres which are often long and coarse.

There are many trees all over Krian.

Prices of fruit: 30 to 70 cents per 100 fruits on tree, 4 to 8 cents per 10 fruits in market.

C. *Mangifera odorata.*

Kwini. Plate II, Fig. 6. Usually a large tree, but in Krian only attaining a height of 25 ft. It has a large spread but a relatively small trunk; leaves broad as in the *machang* (*M. foetida*), greyish-green in colour. The tree is easily recognized by the colour and shape of the leaves. Bears up to 200 fruits per season. Fruit large 110-120 by 90-100 by 85-90 mm., weighing 420 to 450 gms. Form oval, plump, almost circular in transverse section, base flat, stem inserted without depression, nak conspicuous. Colour green turning yellowish, with many brown and obvious lenticels. Flesh yellow, flavour strong and very oily, rather fibrous. Seed 90-100 by 45-60 by 20-25 mm., oblong, densely covered with fibres.

Most of the trees are in Semanggol and Selinsing, but there are also some in Bagan Serai and Briah.

Prices of fruit: 3 to 7 cents per fruit on tree, 5 to 8 cents per fruit in market.

The best varieties are Timun, Sourabaya, Seri Kaya, Cheti, and Kwini, but these trees, with the possible exception of Cheti and Kwini, are not very common in Krian.

Vegetative Propagation.

Little is done in Krian to cultivate the trees or to protect them from pests. Many of the trees grown are of very poor quality and it is possible that if the number of trees of good quality were increased, more interest in the crop would

be aroused and cultivation and pest control with subsequent improvement in marketing would follow. In order to secure such improvement, propagation must be done on vegetative lines.

There are two methods of propagating the mango vegetatively, inarching and budding. Inarching is the classic method with mangoes and is still used in many countries where labour is cheap. It consists of growing a seedling as stock in a tin or basket and when it is almost $\frac{1}{2}$ in. in diameter it is brought near to a branch of a selected tree of good quality by the insertion of the pot in the cleft end of a bamboo pole or by some similar means. Part of the bark and wood of both the seedling and the selected branch are then sliced off for 2 or 3 ins. and the cut surfaces brought together so that the cambia are in contact and the whole securely bound with waxed tape. When the union is complete, in three to four weeks, the top of the seedling is removed and the branch of the selected tree cut off below the graft, the resulting tree having the root and lower stem of the seedling and the leafy top of the selected tree of known good quality. Such a process cannot be done on a large scale but is easy and might be done by the Malay peasants themselves who want only a dozen trees or so.

Budding has proved a successful method of propagating the mango, and satisfactory, preliminary results have been obtained. Stocks should be grown in seed beds and the best results will probably be obtained by using fresh seeds from which both the flesh and husk have been removed. Budding should be done in wet weather when the seedlings are about six months old, using budwood from the third and fourth flushes from the end of the branch. Such budwood will be fairly mature, smooth and green and should have had the leaves from the end of the branch removed so that at the time of budding the buds are just commencing to swell.

There is still much to be learnt regarding budding the mango under local conditions. There is some evidence that multiplication stock beds may be treated in the same way as rubber, and the shoots cut hard back after the budwood has been used. The bud patch should be opened after about eighteen days and the stock cut back, when the bud will begin to grow. It is important that the budded plant is not lifted from the bed until the shoot is at least 2 ft. in length; if it is lifted earlier the stem is very liable to dry out and the plant to die. Good plants are ready for transplanting within a year from planting the seed as stock.

So far, knowledge regarding suitable stocks for the Indian mango is meagre. Such stocks that have been used are the commercial types grown in Krian but they have not been used in sufficient quantity or variety to obtain any reliable information. As already pointed out there are many indigenous species but so far there has been little opportunity to test these. It is known that the *machang* and Kwini are compatable stocks for the Indian mango, and that they may be budded successfully, but whether there is advantage in using these or other species as stocks for local conditions is problematical.

All the most important mangoes in Krían are polyembryonic, that is to say in addition to the embryo that has resulted from fertilization of the carpel there are other embryos which are not the result of fertilization and so should be identical genetically with the parent trees. If the seedlings produced from such embryos can be identified and isolated, a third method of vegetative propagation will become available.

Pests.

Mango trees are particularly liable to damage from insect attack in Malaya, and in some areas a healthy tree is the exception. The commonest pest in Krian is the grub of a Cerambycid (Long horn) beetle, *Rhyctidodera simulaus,* which bores into the branches of the tree. There is some doubt at present whether this is a primary or secondary pest. The grub in the branch can be killed by sawing off the branch below the dead portion and by inserting a piece of flexible wire into the hole and prodding the grub, but such a measure is only temporary as the tree may be attacked again. Prevention can probably only be obtained by improving the conditions in which the tree lives, by cultivation, manuring, and pruning, and possibly by shading.

The leaves of the mango tree are eaten by the larvae of a moth, *Porthetria beatrix,* but although a tree may occasionally be completely defoliated the damage is usually not severe. The smaller branches and leaves are attacked by several species of scale insects and sucking bugs and with young trees of good quality and in nurseries it may be necessary to control them by spraying with an oil emulsion.

The fruit, especially that of the Kwini, is often attacked by the larvae of a weevil, *Cryptorrhynchus gravis;* satisfactory control measures are not known but it is considered in Krian that it occurs less frequently on trees on which *kerengga* ants (*Oecophylla* sp.) have made nests.

Acknowledgments.

Mr. E. J. H. Corner, Assistant Director of Gardens, Straits Settlements, kindly determined the species grown in Krian, and Mr. J. N. Milsum, State Agricultural Officer, Perak, gave great assistance both in the examination of the varieties and in the preparation of the text. Inche Malek bin Abdullah Fakeh, Agricultural Assistant, and Inche Darus bin Ahmat, Agricultural Subordinate, did much of the field work.

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Selected Article.

COMPOSTS*

Composts in the Old Days.

Composts were formerly much used in British farm and garden practice, and the art of making them was well developed in the middle of the last century when labour was cheap and abundant, and prices of farm produce relatively high. J. Hannan, of Kirk Deighton, Wetherby, Yorkshire, a well-known farmer-writer of those times, describes in Morton's *Cyclopedia of Agriculture* how they should be made. Three kinds were recognized: farm-yard manure composts, lime composts and earth composts. The farmyard manure composts were made by building up alternate layers of farmyard manure and of vegetable waste, each about one foot thick: the surface of the heap was then covered with earth. After the mass had undergone decomposition, the heap was turned and well mixed, then remade and again covered with earth or ashes. The vegetable waste could consist of sods, peat or turf, leaves, heath, moss, rushes, weeds, hedge clippings, seaweed, etc.

Another method used where no farmyard manure was available consisted in making the heap of vegetable waste only, and watering it with liquid manure; he instances a farm where the couch grass gathered from the fallows, and the harrowings of weedy stubbles, especially of beans and peas, gave by this method 200 cart loads of good compost in one summer: a testimony to the profitable use of liquid manure and the weediness of the farm.

Special attention was devoted to the composting of peat in Scotland and Ireland. The peat was left to dry for a few months, then made into a heap of alternate layers, the peat layer being 6 in. thick and the dung 10 in., then peat 6 in. and dung 4 in. and so on. The dung should be fairly fresh, but the heap required watching to see that it did not get over-heated and "fire fanged": in that event it had to be watered.

Alternatively, lime was used instead of farmyard manure, but much less was needed; one measure of lime was recommended for five of peat, but for other vegetable wastes the amounts were not specified.

Earth alone, or soaked with urine or liquid manure, was also used.

The making of compost heaps involved a good deal of labour and it gradually went out of use with the shift towards grass instead of arable, the rising cost of wages, and the fall of prices.

Many gardeners, however, continued to compost their vegetable wastes, making up the heap and in some cases watering it with household slops which were found to facilitate the rotting.

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* By Sir E. J. Russell, Director of Rothamsted Experimental Station. *Agriculture*, Vol. XLVI, No. 8, March, 1940.

Modern Methods of Composting.

(A) Inorganic Accelerators.

The subject was put on to a proper scientific basis in 1921[1], by H. B. Hutchinson and E. H. Richards, who showed that the decomposition of the organic matter in the vegetable wastes (which is the basis of compost making) depended on an adequate supply of air, moisture and food for the organisms that bring it about, and the avoidance of acidity that would hamper their activities. The most favourable temperature is about 100°F.-120°F., but this develops by itself if the other conditions are satisfied: the temperature may rise to 150°F. without harm, but water should be added to make good the loss by evaporation.

For straw containing 0.5 per cent. of nitrogen, they found it necessary to add another 0.72 per cent. If more was added it was wasted, but if less, decomposition was greatly retarded. The source of nitrogen could be animal excretions, notably urine, as in making farmyard manure, or, alternatively, sulphate of ammonia, cyanamide, or similar quick-acting material: where sulphate of ammonia was used, some $\frac{3}{4}$ cwt., together with 1 cwt. finely-divided carbonate of lime, sufficed to treat one ton of straw. Cynamide did not require additional lime. Phosphate might also be needed.

The practical difficulty of rotting straw on the large scale is to get it wet; when this is done and the nitrogen compound added, decomposition proceeds quickly, giving a well-rotted manure.

About 40 per cent. of the original organic matter is lost, but the loss falls entirely on the carbonaceous part and none on the nitrogen. Even when exposed to rain, the compost loses only little nitrogen, in contrast with farmyard manure, which may lose 30 or 40 per cent. Potash is liable to be lost, but not phosphate. In view of these low losses, it is unnecessary to protect the heaps against rain; on the contrary, they should be exposed and flat-topped so that the rain water can soak in and provide more moisture for the organisms. When the work is properly done, 1 ton of straw can make 3 tons of compost; during the process it requires about 800 gal. of water and from $\frac{3}{4}$ to $1\frac{1}{2}$ cwt. of the chemical food, according to its composition.

In order to ensure that the discovery should not be improperly exploited, a patent was taken out and worked by a non-profit-making syndicate, the moving spirit of which was the Earl of Iveagh. Steps were immediately taken to examine large numbers of vegetable wastes; their nitrogen requirement was determined and direct tests were made to see if decomposition proceeded normally with each one.

The nature of the carbohydrate constituents plays an important part in the decomposition, and hard lignin-like material has to be balanced by the addition of softer cellulosic material such as leaves, grass, etc.

In general, however, it is not recommended that woody substances, such as hedge trimmings, prunings, etc., should be composted; they are better burnt.

The heap is made in a shallow pit dug about 2 ft. deep, but the excavated soil is put round the sides so that the actual depth becomes much greater. The vegetable waste, while still fresh, is laid in a layer of about 6 in. and wetted if necessary; the

chemical is then added at the rate of 1 part to 20 of dry matter of the waste, which works out to about 2 lb. per large barrow load. New layers are then added till the heap is sufficiently high: it is then left for 2-6 months, during which time, however, it should be turned at least once, otherwise the top layer remains undecomposed. Sufficient heat is generated to kill seeds of annual weeds, but one cannot be sure of destroying fresh roots of bindweed, couch grass, dock and similar resistant weeds: these are better burnt.

Grass cuttings should be mixed with about 10 per cent. of straw so as to ensure a more even type of decomposition.

Good composts made from garden rubbish may contain as much nitrogen as farmyard manure, and more phosphoric acid and potash. The averages of E. H. Richard's samples were:—

Percentage Composition.

	Dry Matter	*Organic Matter*	*Nitrogen* (N)	*Phosphoric Acid* (P_2O_5)	*Potash* (K_2O)
Compost from garden rubbish ...	29.3	13.0	0.66	0.60	1.12
Ordinary farmyard manure ...	23.9	18.9	0.53	0.23	0.56

Much work has been done on the subject at the Cheshunt Experiment Station under Dr. Bewley. Straw decomposed by 3½ months' composting by the Adco method proved as useful as the long horse manure favoured by glasshouse growers. Many thousands of tons of compost have been made by this method, especially by nurserymen and market gardeners in Great Britian and by planters overseas.

Other methods of supplying the food for the organisms are used. Dr. M. A. H. Tincker informs me that at Wisley compost is made from all garden rubbish, including oak and chestnut leaves from the common, woody twigs from Hornbeam hedges etc. The heaps are about 22 yd. × 4 yd. × 5½ ft: the "starter" used is sulphate of ammonia and a little powdered chalk: and the heaps are watered with a garden hose. The time required depends on the proportion of soft grass clippings: if this is adequate, six months in winter is usually long enough for the making of a good manure.

Pine needles should not, however, get into the heap; they are liable to diminish the value of the compost.

(b) Farmyard Manure as Accelerator.

Where farmyard manure is available, it can be used as in the old days for composting. On the Continent, a modification of Kranz's so-called hot fermentation method (designed for making high-grade dung) has been used. The vegetable waste is mixed with dung to form the foundation layer of the heap: daily additions go in turn to quarters of the heap, each lot being left loose and open until it becomes hot; it is then trampled down. Four such layers are made, each of them in the first instance 2-3 ft. thick. Each is trodden down and moistened uniformly with

dilute liquid manure. During the first or aerobic decomposition, the temperature rises sufficiently to kill weed seeds: after it is compacted, anaerobic decomposition continues. The final heap is about 10 ft. high, and is covered with earth and left for 3 to 5 months.

At Cheshunt, good results have been obtained by a much simpler method: compost is made of thin layers of horse manure sandwiched between thicker layers of straw. Composting is not even necessary: straw can be sprinkled with sulphate of ammonia or a complete fertilizer, and put straight into the soil; in farming practice, ploughed down.

(c) Easily Decomposable Vegetable Matter as Accelerator.

The First Indore Process. Composts are particularly important in those tropical countries where farmyard manure is used as fuel and where, therefore, other methods of manuring the land have to be adopted.

India is a notable example, and Hutchinson and Richard's work proved of great importance there. The particular sources of nitrogen used in England were not very suitable, but alternative sources were found. In the so-called Indore method devised by Sir A. Howard the source of nitrogen is young vegetable matter containing more nitrogen than is needed for its own decomposition, and, therefore, with nitrogen to spare for decomposition of material inadequately supplied. The difficulty about water supply is minimized by putting earth into the heap; this holds water and so ensures a reserve that prevents the heap drying out. In parts of India it is possible to obtain earth from cattle stables, and the urine supplies nitrogen for facilitating decomposition.[2]

(d) Habitation Wastes as Accelerator.

Yet another method, also from Indore, was worked out by F. Keith Jackson and Y. D. Wad, where habitation wastes and human excreta and the ordure that otherwise lies about the streets of an Indian village were used. This furnishes nitrogen for the decomposition and has the advantage of encouraging public cleansing of the village: even if the material had little fertilizer value the process would still be worth while for the sake of keeping the village clean.

Dr. Gilbert Fowler has also worked out a method using habitation wastes and human excreta. Others have been studied at Bangalore.[3] Methods of this type are of obvious importance in places where there is no water-borne sewage system, and where, therefore, excrementitious material is available.

Materials Used for Composting on the Farm.

In gardens, nurseries and market gardens where no animals are kept, there is a supply of material of various kinds for composting, but on most English farms there is generally very little that in practice can be composted. Such things as sods, weeds, leaves, moss, etc., do not usually occur in sufficient quantity to make composting possible. Leaves of mangolds are far more conveniently ploughed in, so

also are green manure crops; sugar-beet tops are better fed to animals and hedge trimmings must in any event be burnt. Potato haulms are a possibility and, as shown later, there is no clear evidence that diseases survive composting. In some districts, however, peat can be obtained.

Peat for Composting.

Peat has proved useful as material for composting. In horticultural work, its value is well established and before the war a good deal was imported into this country from Germany and used for this purpose. Methods of making composts for potting have been described by Lawrence and Newell of the John Innes Horticultural Institute.[4] Experiments on the making of peat composts for manure on an agricultural scale are being made by the Macaulay Institute in Lewis, thus reviving an old Scottish practice: good results were obtained from a mixture of 10 tons peat, 1 ton farmyard manure, 5 cwt. basic slag and 2 cwt. 30 per cent. potash salt. Considerable heat is developed, and after some months the material breaks down to a dark brown, dry, friable mould which makes an excellent manure.[5] The investigations are still proceeding, but it appears that sphagnum peats take longer to compost than *Eriophorum* (Cotton grass) peats, and these longer than fen peat.

Waste Straw for Composting.

The commonest waste materials are those thrown out from the threshing machine, and straw in excess of animal requirements and not saleable or otherwise usable. Threshing waste, however, contains many weed seeds, and farmers are rightly nervous about using it as a source of manure, hence it is usually burnt. This is certainly the safest and, in present circumstances, probably the best procedure.

We are finally left with waste straw (i.e., straw which cannot be made into farmyard manure by the animals) as the only practicable material that can be composted, but this constitutes a really difficult problem which, on the farm, has not yet been solved in spite of many efforts at Rothamsted during the past seven years. The first difficulty is to wet the straw uniformly, and short of putting it into a tank of water or passing the straw through a special machine that cuts the straw, waters it, and adds the accelerator, no satisfactory way of doing this has been found. Samples made at Rothamsted by setting up the heap, watering from the water cart and the rain, yielded poor material containing 0.3-0.45 per cent. of nitrogen, 0.25-0.35 per cent. of phosphoric acid (P_2O_5) and 0.16-0.3 per cent. potash (K_2O), which gave definitely poorer results than farmyard manure. Attempts have been made to dilute farmyard manure with straw: these are still going on, but as yet with little promise of success. In an experiment with potatoes, dung (15 tons per acre) alone was compared with dung (the same-sized dressing) *plus* 2 tons chopped straw. The addition of the straw was of no visible advantage: indeed, there was a slight but not significant depression in yield of the potatoes and no significant benefit to the succeeding oat and clover crops.

A very ingenious method of composting straw was devised by E. H. Richards and put into operation at the Wainfleet camp during the 1914-18 war. The straw was set up in the form of a filter in three sections over which the sewage from the camp was passed. The micro-organisms multiplied rapidly and absorbed the nitrogen, decomposing the straw and producing a good manure rich in nitrogen, and at the same time purifying the sewage and converting it into a harmless effluent.[6] The method was tested at a Land Settlement and gave very promising results: it might be desirable to revive it. So far, the simplest way of dealing with excess straw is to put it on the land in winter or early spring, add a dressing of cyanamide or sulphate of ammonia as accelerator, and plough it in, leaving it to rot in the soil.

Do Plant Diseases Survive in Composts?

It is not possible to state definitely whether plant diseases are, or are not, likely to be spread through diseased material that may have got into the compost heap. No direct experiments have been done on the subject. Bewley found that tomato stems and leaves carrying spores of *Verticillium* disease were dangerous in the compost heap and badly infected the next crop. On the other hand, there is no evidence that the spores of ordinary blight (*Phytophthora infestans*) would survive composting of potato haulm, though Wart Disease and Pink Rot might do so. In gardens it is impossible to avoid diseases completely, and while certain of them, such as virus diseases and others, would not be likely to survive the composting process, others caused by organisms producing highly resistant spores might do so. Possibly Finger and Toe would survive: it is known that its spores remain viable when passed in the dung of cattle and sheep.[7]

Evidence of the Value of Compost.

In view of the great amount that has been talked and written about composts, there has been surprisingly little field experimental work on the subject. There is little doubt that well-made compost has considerable fertilizer value, but actual figures are almost entirely lacking, and therefore no comparisons with artificial fertilizers or farmyard manure are possible, nor are figures of cost under English farm conditions available.

A good deal of compost has been made on tea estates in North India, where the necessary vegetable matter is easily collected from the uncultivated land near the estates. The collection of this material has, however, in places led to bad soil erosion.

It is stated that the results are best when sufficient quantities of cattle or other animal manure are available; they are said to be less satisfactory where the animal material has been deficient.[8] Attempts to run the tea estates on compost alone, however, proved unsatisfactory: it was necessary to provide the proper artificials.

There has been much discussion among tea planters as to whether green material should be worked into the soil as green manure or made into a compost. On this subject, definite and good experiments have been made by H. R. Cooper, at the Assam Tea Research Station, and by T. Eden, of the Ceylon Research Institute. In no instance was there any evidence of the advantage of composting, and tea planters are now, therefore, recommended to dig in their green manures.

General Conclusion.

The value of well-made composts in gardens, market gardens and nurseries is beyond doubt, though incontrovertible figures are not available to prove this. The accelerator may be inorganic, such as sulphate of ammonia plus chalk or limestone, cyanamide, Adco or other easily available nitrogenous compound: with the two former, phosphate is also needed; or the accelerator may be farmyard manure: easily decomposable vegetable matter: habitation wastes, household slops containing nitrogenous matter, etc. The value of composts on the farm is not yet established. The material most generally available is straw, but the difficulty of proper water supply is not yet overcome, and composts made with unsatisfactory water supply have not proved particularly effective. The better utilisation of waste straw on the farm is among the most important agricultural problems.

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Reviews.

Timber Utilization in Malaya.

By H. E. Desch and A. V. Thomas. Malayan Forest Records No. 13. Forest Department, Federated Malay States. 75 pp. and index, 35 plates, 10 figs. Price $3 (Malayan) or 7s. 6d. post free.

A comprehensive and easily understood book, with a number of excellent and helpful illustrations, which should be of great value as a useful guide to the selection of timber for various constructional purposes. The preliminary chapters deal with the exploitation of Malayan forests, the anatomical structure of wood and the identification and classification of local timbers. The remaining chapters are concerned with the seasoning of timber, defects, wood preservation, the mechanical properties of timber, and design in relation to correct utilization of timber in new buildings.

The objects and scope of this book are concisely stated in the Introductory Note by the Adviser on Forestry in the following words:—

> "This *Record* by two members of the Research staff of the Malayan Forest Service deals (in language that has been kept as free as possible from technical terms) with the commoner commercial timbers of Malaya, and offers advice as to how the best results can be obtained from them.
>
> It is not intended to be exhaustive: for one reason because our knowledge in this vast field is still comparatively limited; for another because anything in the nature of a comprehensive statement would be so technical and voluminous that it might repel the very class to which this publication is specially dedicated, *i.e.*, the actual users of wood. The book's appearance at this critical period of increasing difficulty in obtaining supplies of so called "permanent" building materials is timely, for not only does it offer advice as to how the shortage may be met, but it also shows that the stigma of impermanence attaching to wood is very largely due to carelessness and ignorance on the part of the builder or architect.
>
> It is obvious enough that no timber can be expected to remain impervious to the attacks of wood-destroying insects and fungi if it is used in just such a manner as to provide optimum conditions for those pests, as has been only too often the case in the past. The maintenance costs of wooden buildings erected without regard to prevention of attack, and providing no means of inspection of vital points, cannot but compare unfavourably with those of structures built from materials that are immune to insects and fungi, but such comparisons are grossly unfair. The authors show how, by observing a few elementary rules, the secondary hardwoods and many of the general utility timbers can safely be used for purposes hitherto strictly limited to the primary hard woods, and how maintenance costs can be reduced to insignificant proportions throughout.

Another point that is stressed is the importance of proper classification of timbers into groups having similar physical properties, and particular emphasis is laid on the use and misuse of the terms "hardwood" and "softwood". These are inapplicable to Malaya because the latter class (as understood in trade circles) is entirely unrepresented among our commercial timbers. The former is, therefore, quite meaningless unless qualified by the words "primary" or "secondary" to distinguish between those that are naturally durable under adverse conditions, and those that are not. If it is necessary to specify hardness, it is permissible to talk of a "hard wood". But safest of all is to specify the timber by its actual name or at least by its group."

Annual Report on the Veterinary Departments, Malaya, for the Year 1939.

By W. R. Wallace. F.M.S. Government Printing Press, Kuala Lumpur. 14 pp. Price $1 or 2s. 4d.

The activities of the Veterinary Departments, Malaya, for the year under review are here recorded in abridged form in accordance with instructions concerning the preparation of Annual Reports during the period of the war.

It is noted that there have been increases in the population of all classes of livestock with the exception of swine. The number of swine decreased by 8 per cent., due it is thought to the low wholesale prices prevailing during the latter months of the current year, combined with the fact that in comparison with 1938 some 32,000 more swine of local origin were slaughtered in those abattoirs in the F.M.S. and S.S. from which reliable statistical returns are regularly received. "Past experience" the Report continues "has indicated that the swine-breeding industry reacts rapidly to fluctuations in the wholesale market price of pigs and it is therefore anticipated that with the remunerative rise in prices which occurred towards the end of the year the industry will soon attain its former level of production." The reviewer considers that another factor which will probably result in an increased swine population is the extension of the tapioca industry which is evident in certain centres. Amongst Chinese tapioca producers, swine keeping is an almost necessary adjunct in order to turn the waste product of the industry into money.

The Department paid particular attention to the problem of increasing local supplies of goat meat for which there is a considerable demand, necessitating the importation of large numbers of goats from foreign sources. This is an encouraging development for we have always held the opinion that there is opportunity for an extension in this direction to supply the small-holder with a welcome addition to his slender income.

The Report devotes considerable space to diseases and their control. It is evident that progress in this direction depends in no small measure on the co-operation of the public. As an instance of this it is stated that there was an outbreak of undiagnosed disease on a large poultry farm situated about 14 miles from Singapore. "The outbreak was not reported until after all the birds involved, numbering some 20,000 head, had died." The Report pertinently states that "it was not possible to carry out investigations into the cause of the disease and there was no material available for examination." There is a wide field for research work in Malaya,—this is, in fact, shown by the account of research work, necessarily brief, given in this Report—but it is obviously essential that the Department should be given early information of outbreaks of disease.

The Report estimates that the total approximate value of locally-bred livestock slaughtered in Malayan abattoirs during the year was $14,778,500, a figure which takes no account of animals slaughtered in the more remote village abattoirs, in the Penang rural area, in Trengganu, or of the relatively large numbers of animals, goats particularly, slaughtered privately in village homesteads, rubber estates and other plantations. This is a particularly interesting figure, for the value of net imports of livestock for food and meat in 1939 was approximately $4,500,000. It appears therefore that the total value of meat consumed in Malaya was in the region of $20,000,000 of which no less than 70 per cent. was locally produced. Malaya, therefore, is self-supporting in this respect to a very much greater degree than is generally thought, and one may confidently anticipate that under present conditions the proportion of local production to total consumption will show an even more favourable balance in 1940.

D. H. G.

Notes and Comments.

ANNUAL REPORT ON THE DEPARTMENTS OF AGRICULTURE, MALAYA, FOR THE YEAR 1939.

For reasons of economy this annual report has been considerably abridged. It is pointed out, however, that articles reviewing in detail the more important industries have been published in the *Malayan Agricultural Journal* during 1940, while statistical information is given in detail in *Malayan Agricultural Statistics 1939*. For these reasons, the present report is only a brief resumé of conditions during the year.

Writing of the general trade conditions during 1939 the report states that up to the outbreak of war, prices remained low and trade in many products was featureless. Following the declaration of war, prices were erratic, nominal in many cases; movement of stock was hampered by shipping difficulties and reorganization, and for certain products there was, therefore, but a small trade passing. During the last quarter of the year the position became clearer; prices, however, showed no inclination to move either way, with the exception of rubber, sago and tapioca which appreciated in value.

The threat and subsequent outbreak of hostilities brought the question of foodstuff production into great prominence. Vital as it is to Malaya, this question is one of peculiar difficulty under local conditions. Food crops other than rice cannot be grown in Malaya continuously, or on non-virgin land without resorting to heavy manuring with organic manures. Further, the majority of the population are essentially rice eaters and will not substitute other foodstuffs for rice except under stress of circumstances. Any great increase in other foods would not find a market so long as rice is available at a reasonable price. For these reasons the main effort has been directed to acceleration of existing programmes for provision of irrigation facilities for rice cultivation and the better utilization of land already under cultivation. Propaganda for cultivation of other foodstuffs has been limited to that necessary for domestic consumption, whether by the individual or by labour forces of plantations and mines.

Reviewing the major agricultural industries the report states that rubber experienced a good year, due to the demand for the commodity and the satisfactory working of the second International Agreement. A noteworthy feature was the considerable increase of exports in the form of concentrated latex.

The prices of coconut and oil palm products remained low and the industries face a very anxious future. Investigations in the Department have been mainly directed to the improvement of the export products to meet the requirements of new or potential markets.

The Central Board of Pineapple Packers, Malaya, officially came into being and an Association of growers was also formed during the year. These two bodies have effectively controlled production and prices and this timely re-organization of the industry has proved of assistance in meeting the marketing difficulties occasioned by the war.

The Report mentions that prices of imported rice, subject to control, remained normal. Crops in most parts of the country were satisfactory. The area planted with "wet" padi constituted a new high record. Investigations on improved strains of rice were continued. This work has now reached fruition in that improved strains are in many areas grown on a large scale and command a premium at the mills.

The growing independence of Malaya of imported agricultural products is instanced by the production and local sale of Malayan tea. Production continued to expand and 17 per cent. of local consumption was produced in this country. Malaya entered the second International Tea Agreement on terms which limit further expansion of the industry in Malaya. The control arrangements continued to work smoothly.

Writing of the less important crops, the report states that derris exports showed a considerable advance despite weak prices. Investigations have been continued to improve the quality of the product and considerable advances were recorded. Interest in tobacco cultivation has increased, local production taking a large share of the market for the cheaper brands of cut tobacco, cheroots and cigarettes. The area under vegetables increased and there was continued interest in the planting of improved stocks of various fruits. Canning trials on many fruits and other products have been made and give great promise.

The School of Agriculture concluded a successful year and commenced the new year with as many students as could be accommodated. Poultry investigations were continued and feeding trials conducted to give special consideration to substitute foods owing to the difficulty in obtaining imported food. Experiments designed to supplement the normal diet of native and upgraded fowls under village conditions were commenced in various parts of the country.

Mention is also made of a valuable report by Sir Frank Stockdale, Agricultural Adviser to the Secretary of State for the Colonies, on his visit to Malaya and Java in 1938 which was published early in the year and received careful consideration, and also of a report by the Colonial Advisory Council of Agriculture and Animal Health on the allocation of work on animal husbandry between the Veterinary and Agricultural Departments.

Departmental.

FROM THE DISTRICTS.

Compiled in the Office of the Chief Field Officer from Monthly Reports of Agricultural Officers.

November, 1940.

The Weather.

The weather was wet, as it normally is at this time of year.

In South Perak heavy rain in the mountains caused floods which resulted in damage to agricultural land and to the flooding of roads, in some cases to sufficient depth to make them impassable.

Crop Reports.

Rubber.—Rubber has increased in price, good quality smoked sheet fetching $47 to $48 per picul. Uncouponed rubber was selling for as much as $20 per picul. Owing to the wet weather tapping was restricted.

Despite the high price of rubber, replanting is still being undertaken by small-holders. Most of these replanted holdings will be budded. Tj 1 is at present the most popular clone. At some Agricultural Stations supplies of budwood of this clone have been temporarily exhausted and although ample supplies of budwood of other well-known clones are available many small-holders will not be persuaded to use them. They prefer instead to buy Tj 1 from estates even though it costs them more. Fortunately large supplies of this clone are available on estates and in all districts small-holders have been able to obtain supplies at a low price from this source. In 1941 adequate supplies of budwood of some of the best proprietary clones will be available for small-holders at Agricultural Stations.

In Johore it is reported that many wealthy Chinese from Singapore, Malacca and Seremban have been endeavouring to purchase rubber estates. As a result prices of rubber land have risen.

There was an interesting and startling occurrence at Pengkalan Pegoh in Perak. Three acres of rubber land subsided 20 ft. and all the trees were destroyed. It appears that similar subsidences have occurred in this locality in the past. The cause is believed to be the action of subterranean streams which dissolve the underlying limestone rock.

In Perak considerable sheet erosion has occurred on land which has recently been planted. In such cases steps are being taken to get the owners to plant cover crops or undertake other measures to stop this erosion. In Johore every new title for rubber land of a hilly nature contains clauses which stipulate that certain specified precautions shall be taken with the object of preventing erosion. These clauses are rigorously enforced, and advice as to the construction of earth-

works and planting of covers is given by Agricultural Officers. Agricultural Officers report that these special anti-erosion conditions are in the majority of cases satisfactorily complied with.

Padi.—In Lower Perak floods have damaged the crop, but owing to the difficulty in inspecting areas under flood it is not yet possible to give details as to the extent of the damage done. In Stage IV at Sungei Manik damage is likely to have been severe. Bunds were breached by the flood waters of the Sungei Kroh and Sungei Kinta and some 1,000 acres have been inundated to various depths. It is also evident that small padi areas in the vicinity of the Perak River must have suffered as padi plants can be seen floating down the river.

There have been some reports of rat damage. In the Kuala Kangsar and Parit areas damage is reported to have become rather serious and every means of control is being vigorously applied.

Poultry.—This has been bad weather for poultry, particularly for chicks. Mortality from chills among young stock has been heavy.

Grazing Grounds.

In Kelantan work on the establishment of grazing grounds is being continued. New grazing areas are being felled and planted with grasses under the supervision of the Department of Agriculture. The work is done by the local land owners who all turn out and share in the labour. At one such "meeting" on the Bukit China grazing ground in one day the people planted 16 acres of land with carpet grass cuttings and clean-cleared and burned another 4 acres.

The problem of stock feeding is also being examined from other angles. Many promising indigenous grazing and fodder grasses are being tried out. Padi straw may also prove to be a useful food.

DEPARTMENTAL NOTES.

Leave.

Mr. J. L. Greig, Agricultural Officer, has been granted 221 days leave from 3rd December, 1940, to 11th July, 1941 inclusive.

Mr. A. E. Coleman-Doscas, State Agricultural Officer, Johore, returned from leave on the 23rd November, 1940.

Statistical.

MARKET PRICES.

November, 1940.

Major Crops.

Rubber.—There was an improvement in the Singapore price of rubber in the second week of the month but the market fell back in the second half of the month. No. 1. X. Ribbed Smoked Sheet opened at 38¾ cents per lb. and rose to 39¼ cents on the 13th and 14th November, after which it weakened to close at 38¼ cents.

The average of daily quotations for the month was 38.69 cents per lb., as compared with 38.01 cents in October. The London average price was 11.78 pence per lb., and New York 20.72 cents gold, as compared with 11.80 pence and 20.13 cents gold in October.

Prices paid for small-holders' rubber at three centres during the month are given in Table 1.

Table I.

Weekly Prices Paid by Local Dealers for Small-Holders' Rubber, November, 1940.

(Dollars per picul of 133 1/3 lbs.)

Grades	Kuala Kangsar, Perak				Kuala Pilah, Negri Sembilan		Batu Pahat, Johore.		
	6	13	20	27	7	14	6	13	27
Smoked Sheet ...	46.00	46.00	46.00	46.09	47.40	47.70	—	46.50	—
Unsmoked Sheet ...	—	43.78	44.00	43.25	—	—	44.50	43.90	44.00
Scrap ...	—	—	—	—	—	—	—	—	—

Transport by F.M.S.R. lorry service Kuala Pilah to Seremban 12 cents per picul, to Malacca excluding duty, 25 cents per picul, by rail Seremban to Penang $1.24 per picul, Seremban to Singapore $8 per ton.

Transport from Batu Pahat to Singapore by lorry, excluding duty, 90 cents per picul.

Transport from Kuala Kangsar to Prai by railway $6.20 per ton.

At Kuala Pilah the standard deduction for moisture in unsmoked sheet is 5 per cent.

No purchases of rubber at Batu Pahat on the 20th November, and at Kuala Pilah on the 21st and 28th November.

Palm Oil.—Local sales of palm oil in sellers' drums were made in November at the following price:—bleached oil 5 per cent. f.f.a. $127.50 per ton f.o.b. Port Swettenham.

Copra.—The sun-dried grade opened at $2.50 per picul but fell to $2.40 on the 11th November at which level it remained unchanged until the end of the month, averaging $2.43 per picul for the month as compared with $2.50 in October. The mixed grade remained 25 cents per picul lower than the sun-dried grade.

Coconut oil was sold in Singapore during November at an average price of $6.50 per picul.

Copra cake was unchanged at $1.10 per picul.

Rice.—The Singapore average wholesale price for Rangoon Parboiled No. 2 was $6.07 per picul. There were no dealings in the remaining grades usually quoted in this report.

The September average retail prices in cents per gantang (gallon) of No. 2 Thai rice were: Singapore 33, Penang 34½, as compared with 32 and 34½ respectively in August. Malacca is not quoted.

The average declared trade value of imports during September was $5.04 per picul, as compared with $4.63 in August and $4.38 in July.

Padi.—The Government Rice Mills, Perak, are paying a guaranteed price of $2.50 per picul for padi, plus a bonus of 10 cents per picul for pure strain S.K. 48 padi. The Government Rice Mills, Temerloh, Pahang, continued to pay $2.25 per picul.

Retail prices of padi in cents per gantang (gallon) were as follows:—Kedah 10 to 10.4, Penang and Province Wellesley 14.3, Perak 12 to 18, Pahang 12 to 22, Malacca 17 to 20, Kelantan 12¾.

Pineapples.—Prices of the canned product continued unchanged.

Fresh fruit prices were again altered and the following table of rates became operative on the 15th November.

Class of Fruit	Average Weight of 100 Fruit	Price for every 100 Fruit less than Half-Ripe			Premium for every 100 Fruit at least Half-Ripe
		Johore and Klang	Singapore		
			Kranji	Serangoon and Grove Road	
	lbs.	$	$	$	cents
1½ lbs. to 2½ lbs. ...	200	.66	.77	.83	nil
2½ lbs. to 3½ lbs. ...	300	1.00	1.17	1.25	nil
Over 3½ lbs. ...	400	1.34	1.56	1.67	nil

Beverages.

Tea.—There are no London tea sales.

The latest Colombo prices available, quoted from *The Ceylon Tea Market* Report of 26th November, 1940, of the Colombo Brokers' Association, are as follows, in rupee cents per lb.: High Grown 93, Medium 87, Low Grown 86.

Coffee.—Liberian coffee improved from $14.50 to $15 averaging $14.88 per picul. Excelsa continued unchanged at $11.50. Robusta rose from $8 to $8.50, but fell again to $8, averaging $8.25.

The averages of highest and lowest quotations in Singapore for Palembang coffee were $13.31 to $15.44 and for Sourabaya coffee $16 to $18.31.

The October average prices were $10.10 to $11.30 and $13.25 to $14.25 respectively.

Spices.

Arecanuts.—The averages of the Singapore Chamber of Commerce quotations per picul, which were stated to be approximate, were:—Best $6.55, Medium $6.15, Mixed $5.60, as compared with $6.31, $5.94 and $5.50 respectively in October.

The averages of the highest and lowest quotations per picul in Singapore were as follows:—Splits $4.94 to $7.69, Red Whole $7.62 to $9.50, Sliced $8.94 to $11.69, as compared with $4.95 to $7.70, $5.75 to $7.75 and $11.55 to $14.80 respectively in October.

Pepper.—Singapore Black continued unchanged at $12 per picul. Muntok White rose from $12 to $13, averaging $12.80, as compared with $12 in October. The market for Singapore White continued nominal with no quotations.

Nutmegs.—There was a substantial improvement in both grades; 110's rose from $20 to $26 per picul, averaging $22, and 80's rose from $22 to $28, averaging $23.80. The October prices were $20 and $22 respectively.

Penang dried nutmegs were sold at $14 per picul.

Mace.—Amboina was quoted nominally throughout the month at $28 per picul, as compared with an average price of $27.75 in October. Siouw was not quoted.

Locally produced mace, dry, was sold in Penang at $40 per picul.

Cloves.—A nominal market with no quotations. Penang cloves, dried, sold in Penang at $56 per picul.

Cardamoms.—Green cardamoms were quoted in *The Ceylon Chamber of Commerce Weekly Report* of 25th November, 1940, from Rs. 1.50 to Rs. 1.83 per lb.

Miscellaneous.

Derris.—There was fair enquiry during November but not at a price level higher than that ruling during the previous two months. Purchases in the main consuming centres for the coming spring season appear to be nearing completion. Average prices per picul for the month were as follows:—$9.50 to $10.50 for root sold on a basis of ether extract; $20 to $23 for root with 4 to 5 per cent. rotenone content, rising to $27 to $28.50 for 7 to 9 per cent. rotenone.

Gambier.—No. 1 Cube continued unchanged at $14 per picul. Block was not quoted.

Sago.—Shortage of supplies caused prices to rise. Pearl fell from $6.25 per picul to $6, but closed at $8, averaging $6.55. Flour, Sarawak Fair, fell from $4 to $3.25, but closed at $3.75, averaging $3.50. The October average prices were $5.70 and $2.99 respectively.

Tapioca.—Prices improved at the close of the month. Flake Fair rose from $6.50 to $7 per picul, averaging $6.60; Seed Pearl rose from $6.50 to $8, averaging $6.80; Medium Pearl rose from $7.25 to $8, averaging $7.40. The October prices were $6.50, $6.50 and $7.25 respectively.

Tobacco.—Prices of prepared tobacco per picul in Kelantan during November were: 1st quality $120 to $170, 2nd quality $75 to $135, 3rd quality $45 to $115. The range of dried leaf prices per picul was as follows: Kedah $38 to $40; Perak Central 1st quality $37 to $45, 2nd quality $28 to $29, 3rd quality $15 to $17; Perak South $45, $40, $35; prepared tobacco 70 to 75 cents per kati; Pahang $26 to $30, $15 to $25, $8 to $15; Penang and Province Wellesley $39, $30; Malacca $35 to $38; Selangor, cut tobacco $1 to $1.30 per kati at Sabak Bernam only.

The above prices are based on London and Singapore daily quotations for rubber, on the Singapore daily prices for copra, on the Singapore Chamber of Commerce Weekly Reports for the month and on other local sources of information. Palm oil reports and certain coffee prices are kindly supplied by Guthrie & Co., Ltd., Kuala Lumpur, local palm oil prices by Whittall & Co., Kuala Lumpur, the Singapore prices of imported coffee and arecanuts by Lianqui Trading Company of Singapore, and Singapore derris prices by Hooglandt & Co., Singapore.

1 picul = 133 1/3 lbs. The dollar is fixed at 2s. 4d.

Note.—The Department of Agriculture will be pleased to assist planters in finding a market for agricultural produce. Similar assistance is also offered by the Malayan Information Agency, 57, Trafalgar Square, London, W.C.2.

MALAYAN AGRICULTURAL EXPORTS, SEPTEMBER, 1940.

Product	Net Exports in Tons				
	Year 1939	Jan./Sept. 1939	Jan./Sept. 1940	September 1939	September 1940
Arecanuts ...	38,489	30,798	33,304	5,684	2,310
Coconuts fresh†‡ ...	97,275†	73,125†	73,316†	6,876†	8,681†
Coconut oil‡ ...	61,360	44,972	47,337	5,449	4,486
Copra‡ ...	34,420	38,806	322	4,316	1,384*
Copra cake ...	10,707	7,352	4,069	1,188	184*
Gambier, all kinds ...	1,572	1,197	609	143	47
Palm kernels ...	10,774	7,227	5,489	730	225
Palm oil ...	59,712	41,959	39,754	2,623	3,013
Pineapples, canned ...	65,802	66,228	32,218	5,931	454
Rubber¶ ...	361,484¶	253,793¶	403,813¶	35,178¶	54,391¶
Sago,—flour ...	9,583	4,666	673	854	1,340
,, —pearl ...	3,883	2,876	3,143	546	668
,, —raw ...	4,435*	3,768*	4,302*	565*	296*
Tapioca,—flake ...	1,068	779	602	204	82
,, —flour ...	2,706*	1,852*	1,804*	44	214*
,, —pearl ...	18,277	13,963	12,003	2,735	1,732
Derris ...	1,356	912	898	186	80
‡Copra equivalent ...	136,075	113,347	78,711	13,307	6,078

† hundreds in number. * net imports. ¶ production.

MALAYAN AGRICULTURAL EXPORTS, OCTOBER, 1940.

Product	Net Exports in Tons				
	Year 1939	Jan./Oct. 1939	Jan./Oct. 1940	October 1939	October 1940
Arecanuts ...	38,489	33,122	37,897	2,325	4,592
Coconuts fresh†‡ ...	97,275†	82,705†	86,801†	9,580†	13,486
Coconut oil‡ ...	61,360	50,107	56,420	5,135	9,083
Copra‡ ...	34,420	42,139	6,953*	3,334	7,275*
Copra cake ...	10,707	7,644	2,537	291	1,532*
Gambier, all kinds ...	1,572	1,301	644	104	35
Palm kernels ...	10,774	8,338	8,289	1,111	2,800
Palm oil ...	59,712	49,078	42,753	7,120	2,999
Pineapples, canned ...	65,802	76,924	32,967	10,696	749
Rubber¶ ...	361,481¶	296,076¶	453,211¶	42,283¶	49,398¶
Sago,—flour ...	9,583	7,856	3,043	3,189	2,370
,, —pearl ...	3,883	3,142	3,617	267	474
,, —raw ...	4,435*	4,246*	4,491*	478*	188*
Tapioca,—flake ...	1,068	856	644	77	42
,, —flour ...	2,706*	1,995*	2,080*	143*	276*
,, —pearl ...	277	15,191	13,505	1,228	1,503
Derris ...	1,356	1,037	989	125	91
‡Copra equivalent ...	136,075	125,217	86,467	11,869	7,754

† hundreds in number. * net imports. ¶ production.

FERTILIZER PRICES, DECEMBER, 1940.

The following are the prices current for the month of December, 1940, of the more important fertilizers of which stocks are available.

	per ton $	
Nitrate of soda	125	
Muriate of potash	200	
Rock phosphate (Christmas Island)	37	($35 Singapore).
Lime	20	

Quotations are *ex* warehouse, Port Swettenham, Klang, Singapore and Penang.

Supplies of sulphate of ammonia, superphosphate, basic slag, calcium cyanamide, sulphate of potash, and rock phosphate (Gafsa) are not available.

MALAYAN PRODUCTION OF PALM OIL AND KERNELS

(In long tons, as declared by Estates).

Month 1940	Palm Oil			Palm Kernels		
	F.M.S.	U.M.S.	Malaya	F.M.S.	U.M.S.	Malaya
January ...	2,007.6	2,474.0	4,481.6	434.3	497.0	931.3
February ...	1,937.9	1,914.7	3,852.6	411.1	454.0	865.1
March ...	2,081.5	1,877.0	3,958.5	445.3	388.1	833.4
April ...	2,104.3	1,820.7	3,925.0	420.8	370.0	790.8
May ...	2,124.3	2,054.1	4,178.4	414.5	401.0	815.5
June ...	2,128.8	2,696.0	4,824.8	268.6	505.0	773.6
July ...	3,217.7	2,886.4	6,104.1	531.4	529.2	1,060.6
August ...	3,801.2	3,049.9	6,851.1	343.1	389.8	732.9
September ...	3,323.7	2,490.6	5,814.3	296.1	294.0	590.1
October ...	2,747.4	2,459,3	5,206.7	381.6	464.0	845.6
Total ...	25,474.4	23,722.7	49,197.1	3,946.8	4,292.1	8,238.9
Total January to October, 1939 ...	25,501.7	21,670.0	47,171.7	4,757.3	3,625.1	8,382.4
Total for the year 1939 ...	30,157.7	27,215.0	57,372.7	5,639.3	4,533.1	10,172.4

Stocks on estates as at 31st October, 1940, were :— palm oil 8,210 tons, palm kernels 1,425 tons.

ACREAGES OF TAPPABLE RUBBER ACTUALLY TAPPED AND NOT TAPPED ON ESTATES OF 100 ACRES AND OVER, FOR THE MONTH ENDING 31ST OCTOBER, 1940.

STATE OR TERRITORY	Estimated Acreages of Tappable Rubber (9)+(11)	ACREAGES OF TAPPABLE RUBBER NOT TAPPED				Area of tappable rubber never been tapped (b)		Total area not tapped (3) + (5) (c)		TOTAL AREA TAPPED DURING THE MONTH		Area of tappable rubber rested under rotational systems (c)	
		On estates which have entirely ceased tapping		On estates which have partly ceased tapping (a)									
		Acreage	Percentage of (3) to (2)	Acreage	Percentage of (5) to (2)	Acreage	Percentage of (7) to (2)	Acreage	Percentage of (9) to (2)	Average	Percentage of (11) to (2)	Acreage	Percentage of (13) to (2)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
S.S.—													
Province Wellesley ...	42,219	114	0.3	6,018	14.2	456	1.1	6,132	14.5	36,087	85.5	8,466	20.1
Malacca ...	113,213	302	0.3	12,631	11.1	746	0.7	12,933	11.4	100,280	88.6	19,858	17.5
Penang ...	2,600	nil	nil	735	28.3	35	1.3	735	28.3	1,865	71.7	60	2.3
Singapore ...	30,356	3,479	11.5	5,921	19.5	239	0.8	9,400	31.0	20,956	69.0	2,987	9.8
Total S.S. ...	188,388	3,895	2.1	25,305	13.4	1,476	0.8	29,200	15.5	159,188	84.5	31,371	16.7
F.M.S.—													
Perak ...	270,682	1,021	0.3	27,589	10.0	3,864	1.4	28,610	10.3	248,072	89.7	33,779	12.2
Selangor ...	305,002	3,159	1.0	19,078	6.3	3,117	1.0	22,237	7.3	282,765	92.7	36,985	12.1
Negri Sembilan ...	252,509	2,398	0.9	29,989	11.9	5,155	2.0	32,387	12.8	220,122	87.2	25,441	10.1
Pahang ...	84,895	1,023	1.2	11,428	13.5	3,938	4.6	12,451	14.7	72,444	85.3	5,377	6.3
Total F.M.S. ...	919,088	7,601	0.8	88,084	9.6	16,074	1.7	95,685	10.4	823,403	89.6	101,582	11.1
U.M.S.—													
Johore ...	467,188	7,002	1.5	57,521	12.3	22,638	4.8	64,523	13.8	402,665	86.2	50,322	10.8
Kedah ...	193,512	5,329	2.8	11,285	5.8	4,049	2.1	16,614	8.6	176,898	91.4	28,056	14.5
Kelantan ...	30,397	403	1.3	4,094	13.5	793	2.6	4,497	14.8	25,900	85.2	4,709	15.5
Trengganu (d) ...	4,817	nil	nil	nil	nil	nil	nil	nil	nil	4,817	100.0	1,839	38.2
Perlis (e) ...	1,329	nil	nil	345	26.0	76	5.7	345	26.0	984	74.0	232	17.5
Brunei ...	5,985	nil	nil	1,196	20.0	260	4.3	1,196	20.0	4,789	80.0	890	14.9
Total U.M.S. ...	703,228	12,734	1.8	74,441	10.6	27,816	4.0	87,175	12.4	616,053	87.6	86,048	12.2
Total MALAYA ...	1,810,704	24,230	1.3	187,830	10.4	45,366	2.5	212,060	11.7	1,598,644	88.3	219,001	12.1

Notes.—(*a*) Area out-of-tapping on estates which have partly ceased tapping refers to areas definitely being rested and excludes areas on any tapping round.

(*b*) The acreage shown in column (7) is included in columns (3) and (5).

(*c*) Areas of tappable rubber rested under rotational systems are not considered as out-of-tapping and therefore columns (11) and (12) include columns (13) and (14) respectively.

(*d*) Registered companies only.

(*e*) Figures for the quarter ending 30th September, 1940.

MALAYAN RUBBER STATISTICS Table I.

ACREAGE, STOCKS, PRODUCTION, IMPORTS AND EXPORTS OF RUBBER, INCLUDING LATEX, CONCENTRATED LATEX AND REVERTEX.
FOR THE MONTH OF OCTOBER, 1940., IN DRY TONS.

State or Territory	Stocks at beginning of month 1			Production by Estates of 100 acres and over		Production by Estates of less than 100 acres estimated 2		Imports				Exports including re-exports				Stocks at end of month			Consumption 3	
								during the month		January to Oct. 1940		during the month		January to Oct. 1940						
	Ports	Dealers	Estates of 100 acres and over	during the month	Jan. to Oct. 1940	during the month	Jan. to Oct. 1940	Foreign	From Malay States	Foreign	From Malay States	Foreign	Local	Foreign	Local	Ports	Dealers	Estates of 100 acres and over	during the month	Jan. to Oct. 1940
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
MALAY STATES :—																				
Federated Malay States ...	...	8,587	15,727	16,114	143,853	8,413	87,665	Nil	Nil	Nil	Nil	18,046	8,414	154,278	84,264	...	5,695	16,567	119	888
Johore ...	...	3,102	6,326	7,406	64,802	6,094	53,969	Nil	Nil	28	Nil	3,025	10,390	37,244	83,613	...	2,703	6,838	...	...
Kedah ...	...	575	3,279	4,010	34,392	1,584	14,143	Nil	Nil	Nil	Nil	1,741	3,577	19,012	32,196	...	496	3,634	...	...
Perlis ...	...	37	20	24	165	42	322	Nil	Nil	Nil	Nil	Nil	58	Nil	486	...	37	28	...	...
Kelantan ...	...	311	440	474	4,166	603	8,906	Nil	Nil	Nil	Nil	400	714	2,105	11,256	...	223	491	...	...
Trengganu ...	...	77	130	216	1,853	358	3,606	Nil	Nil	Nil	Nil	5	598	30	5,569	...	62	116	...	...
Brunei ...	...	9	42	72	630	109	952	...	...	...	...	...	187	...	1,617	...	5	40	...	...
Total Malay States	...	12,698	25,964	28,316	249,861	17,203	169,563	Nil	28	Nil	637	23,217	23,938	212,669	219,001	...	9,221	27,714	119	888
S. SETTLEMENTS :—																				
Malacca ...	...	1,986	1,424	1,625	13,598	928	8,383	Nil		Nil		3,847		28,652		...	2,064	1,514	...	...
Province Wellesley ...	...	1,719	659	628	5,316	311	2,655	Nil		Nil		10,710		97,352		...	702	697	...	...
Penang ...	2,428	3,437	12	27	224	105	1,088	1,617	24,219	24,407	212,668		Nil		Nil	4,842	2,242	17	...	...
Singapore ...	5,659	17,545	247	196	1,667	42	705	16,095		179,584		32,578		312,407		12,919	13,635	289	20	188
Labuan ...	...	21	Nil	Nil	Nil	17	151	60		591		Nil		Nil		...	21	Nil	...	...
Total Straits Settlements ...	8,087	24,708	2,342	2,476	20,805	1,403	12,982	17,772	24,219	204,582	212,668	47,135	Nil	438,411	Nil	17,761	18,664	2,517	20	188
Total Malaya ...	8,087	37,406	28,306	30,792	270,666	18,606	182,545	17,772	24,247	204,582	213,305	70,352	23,938	651,080	219,001	17,761	27,885	30,231	139	1,076

TABLE II
DEALERS' STOCKS, IN DRY TONS 3

Class of Rubber	Federated Malay States	S'pore	Penang	P.Wesly M'cca. Labuan & Brunei	Johore	Kedah
22	23	24	25	26	27	28
DRY RUBBER	4,688	12,477	1,937	2,156	1,896	258
WET RUBBER	1,007	1,158	305	636	807	238
TOTAL ...	5,695	13,635	2,242	2,792	2,703	496

TABLE III
FOREIGN EXPORTS

PORTS	For month	Jan. to Oct. 1940
29	30	31
Singapore ...	45,541	447,778
Penang ...	14,875	132,694
Port Swettenham.	9,581	68,853
Malacca ...	355	1,755
TOTAL ...	70,352	651,080

TABLE IV
DOMESTIC EXPORTS 4

AREA	For month	Jan. to Oct. 1940
32	33	34
Malay States ...	47,054	430,629
Straits Settlements	3,626	33,649
MALAYA ...	50,680	464,278

Notes:—

1. Stocks on estates of less than 100 acres and stocks in transit on rail, road or local steamer are not ascertained
2. The production of estates of less than 100 acres is estimated from the formula : Production + Imports + Stocks at beginning of month = Exports + Stocks at end of month. + Consumption, *i.e.*, Column (7) = Columns (13) + (14) + (17) + (18) + (19) + (20) − (2) − (3) − (4) − (5) − (9) − (10). For the Straits Settlements the production of estates of less than 100 acres is represented by sales or exports as shown by cess paid.
3. Dealers' stocks in the Federated Malay States are reduced to dry weights by the following fixed ratios: unsmoked sheet, 15% wet sheet, 25% scrap, lump, etc., 40%; stocks elsewhere are in dry weights as reported by the dealers themselves.
4. Columns (33) and (34) represent exports of rubber subject to regulation which, for Singapore and Penang Islands are represented by sales or exports as shown by cess paid.
5. All statements are brought up to date monthly, and any inaccuracies that may be disclosed are corrected in the totals; the latest publication therefore, is always the most reliable.
6. The above, with certain omissions, is the Report published by the Registrar-General of Statistics S.S and F.M.S., at Singapore on 27th November, 1940

METEOROLOGICAL SUMMARY, MALAYA, OCTOBER, 1940.

Locality.	Air Temperature in degrees Fahrenheit							Earth Temperature		Rainfall								Bright Sunshine.		
	Means of			Absolute Extremes						Total.		Most in a day.	Number of days.					Total.	Daily Mean.	Per cent.
	A. Max.	B. Min	Mean of A and B	Highest Max.	Lowest Min.	Lowest Max.	Highest Min.	At 1 foot	At 4 feet			Amt.	Precipitation .01 in or more	Precipitation, .04 in or more	Thunder-storm	Fog morning obs.	Gale force 8 or more			
	°F	°F	°F	°F	°F	°F	°F	°F	°F	in.	mm.	in.						hrs.	hrs.	
Kuala Lumpur Aerodrome Selangor ...	90.7	72.9	81.8	94	71	87	75	84.7	85.7	10.31	261.9	3.05	17	14	10	5	—	172.55	5.57	46
Port Swettenham Aerodrome, Selangor ...	89.0	72.6	80.8	93	70	84	75	86.0	86.0	7.75	196.9	2.82	19	15	5	2	—	180.15	5.81	48
Sitiawan, Perak ...	88.0	73.5	80.7	91	71	81	75	83.1	84.7	8.12	206.2	1.30	21	18	5	—	—	201.40	6.50	54
Ipoh Aerodrome, Perak ...	89.3	72.7	81.0	92	71	82	75	83.1	84.5	12.98	329.7	1.82	26	22	3	—	—	189.45	6.11	50
Temerloh, Pahang ...	91.3	73.3	82.3	93	71	88	75	87.3	87.6	5.40	137.2	1.63	12	10	5	3	—	206.20	6.65	55
Kuala Lipis, Pahang ...	89.5	72.4	80.9	92	71	84	74	84.1	85.4	4.37	111.0	1.57	20	14	3	28	—	185.55	5.99	50
Kuala Pahang, Pahang ...	87.3	74.5	80.9	91	71	84	76	86.4	87.9	16.30	414.0	6.51	16	12	1	—	1	216.95	7.00	58
Kallang Aerodrome, S'pore ...	87.3	76.6	81.9	89	72	84	81	84.1	84.8	3.32	84.3	1.26	6	5	1	—	—	200.05	6.45	53
Bayan Lepas Aerodrome Penang ...	86.2	74.4	80.3	89	71	81	77	84.1	84.8	9.48	240.8	1.59	25	21	3	—	—	198.30	6.40	53
Malacca Town, Malacca ...	85.5	74.0	79.7	88	72	82	76	84.0	85.5	15.49	393.4	4.28	18	17	3	—	1	215.15	6.94	57
Kluang, Johore ...	89.3	71.5	80.4	92	69	85	74	82.4	83.1	9.07	230.4	1.93	21	17	3	11	—	173.40	5.59	46
Mersing, Johore ...	87.5	72.3	79.9	91	70	82	75	83.1	83.3	4.17	105.9	0.88	15	12	6	1	—	190.40	6.14	51
Alor Star, Kedah ...	87.7	73.9	80.8	92	70	83	76	85.5	86.5	8.72	221.5	1.69	21	19	5	4	—	199.85	6.45	54
Kota Bahru, Kelantan ...	89.2	73.9	81.5	92	72	82	75	85.7	86.0	4.11	104.4	0.94	19	15	3	—	1	209.15	6.75	56
Kuala Trengganu, Trengganu	88.3	73.0	80.7	91	71	80	75	84.6	86.2	3.38	85.9	0.79	11	10	2	2	—	225.80	7.28	61
Labuan ...	87.5	76.5	82.0	90	73	85	80	86.1	87.2	11.01	279.7	1.80	18	17	3	—	1	253.15	8.17	68
HILL STATIONS.																				
Fraser's Hill, Pahang 4268 ft.	74.4	62.6	68.5	79	61	71	65	72.8	72.9	11.52	292.6	2.25	23	21	4	13	—	153.30	4.95	41
Cameron Highlands, Tanah Rata, Pahang 4750 ft. ...	72.2	57.6	64.9	75	52	69	62	71.4	70.9	17.85	453.4	1.86	28	25	2	6	—	136.75	4.41	37
Cameron Highlands, Rhododendron Hill, Pahang 5120 ft. ...	72.3	59.9	66.1	76	58	68	62	*	*	17.58	446.5	1.96	27	23	—	—	—	146.90	4.74	39

* Not recorded.